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CerOrganic Training Curriculum

Module C534
Unit C534a.1: Principles of OA, Legislation, Certification

504387-LLP-1-2009-1-GR-LEONARDO-LMP

Co-funded by the European Union,
through the Leonardo da Vinci Programme

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Structure

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1.i. Tutor information

Studied biology at the Aristotle University of Thessaloniki. Received a Ph.D. in Molecular & Cell biology from the University of California, Berkeley. Coursework in Agroecology as a visiting scholar at the Agroecology Laboratory at the UC Berkeley and on Organic Field Crop Management at Nova Scotia Agricultural College. Taught agroecology at UC Berkeley and Stanford. Research on photosynthesis in Plant Biology Dept. and agroecology at the University Farm at UC Berkeley. Research on organic crop management in Greece. Certification manager for organic agriculture at a Certification body in Greece. Currently teaches at the Dept. of Plant Production at the Technological Educational Institute of Thessaloniki and he owns and manages an organic farm since 2003 in Northern Greece.

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1.ii. Aims & objectives

- Present components and processes of agroecosystems
- offer various e-resources as an introduction to agroecology, and environmental friendly farming systems
- demonstrate inter-relation of various components and effects following specific actions and farming practices
- emphasize principles and processes instead of recipes and technology packages
- illustrate problems and problem-solving approaches for specific case studies

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1.iii. Learning outcomes & skills

By the end of the component, the students are expected to:

- have an understanding of the complexity of agroecosystems
- have an understanding of the relationship amongst soil fertility, plant health and the resistance and resilience of crops to pests and pathogens
- be competent in searching for resources in the literature and the internet
- be familiar with several problems occurring in the field of agroecosystem management and conversion to organic farming and be able to analyze critically various solutions leading to management decisions
- have developed consultation skills on agroecosystem management and conversion strategies to organic farming

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1.iv. Content

Brief description of the unit and/or key concepts (theoretical and practical content).

- Agroecological analysis of organic farming systems. Patterns and processes defining the relationships between the various components of agroecosystems.
- Agroecosystem diversification. Interactions between agroecosystems and natural ecosystems and different farming systems.
- Principles of ecologically based pest management
- Critical analysis and decision-making in managing complex agroecological systems
- Organic Standards - Requirements for organic farming certification
- Managing the conversion process to organic agriculture
- Diversification tools to improve both agroecosystem health and economic stabilty
- Case studies and problems
- Consultation techniques

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1.v. Methodology & media

The Unit is composed of:

- (a) lectures based on PowerPoint presentations
- (b) web-based literature review
- (c) textbooks, articles
- (d) (team) field work
- (e) group interaction and discussion

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2. Main presentation

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Agroecology

The application of ecological concepts and principles to the design and management of sustainable agroecosystems

Module C534, Unit C534a.1

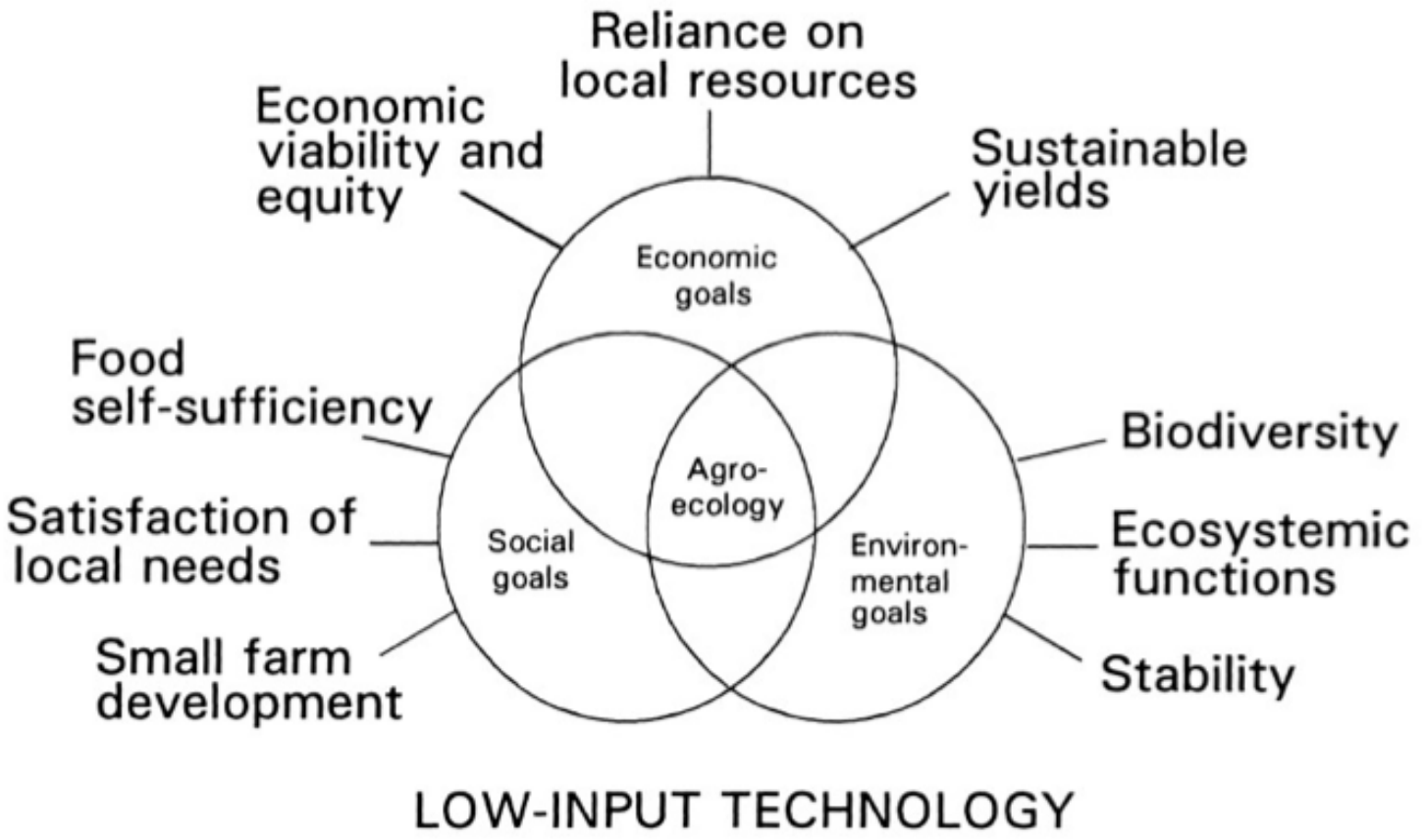
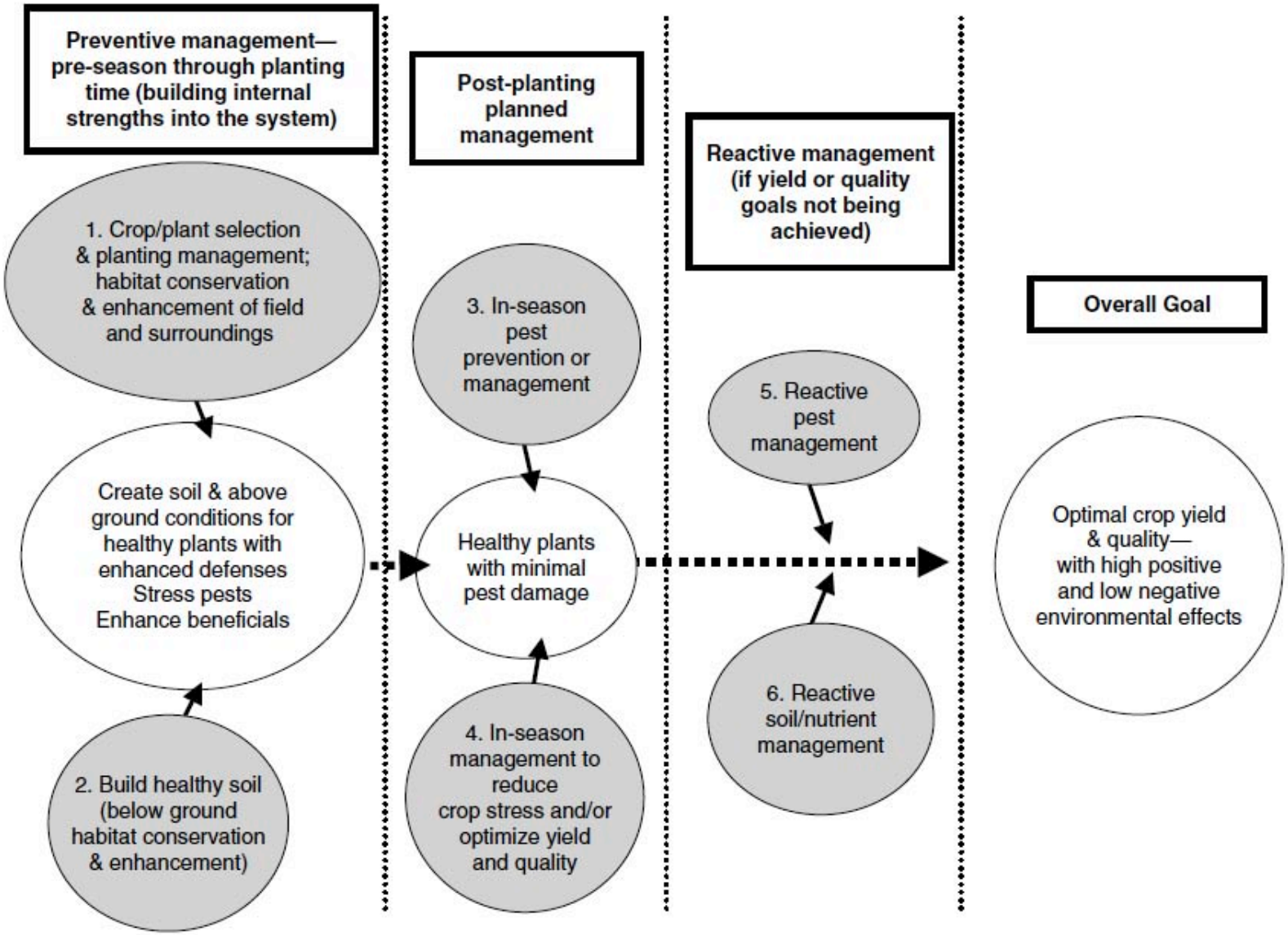


FIGURE 18.3 The role of agroecology in satisfying social, environmental, and economic goals in rural areas.

Source: “Agroecology: The Science of Sustainable Agriculture”. M. A. Altieri (1995) Westview Press, Boulder



Source: Magdoff, F., 2007. Ecological agriculture: Principles, practices, and constraints. Renewable Agriculture and Food Systems, 22(02), p.109.

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Natural Ecosystems

- **Efficiency**
  - efficient energy flows - complex food webs
  - efficient capture of rainfall and nutrient cycling
- **Biodiversity** – enhances recycling of nutrients and regulation of pest populations
- **Self-sufficiency** - require only inputs of sunlight & rainwater
- **Self-regulation** - great diversity prevents outbreaks of organisms (diseases & pests)
- **Resiliency** - recover quickly from disturbances

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Applying principles and processes of natural ecosystems in ecological farming

- Nutrient cycles in forests
  - Recycling nutrients
- Soil fertility in forests
  - Soil protection
- Diversity in forests
  - Crop diversity
- Eco-balance in forests
  - Biological control

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Ecologically Based Pest Management

- systems approach to pest management
- accurately diagnose the nature and source of pest problems,
- apply preventive tactics and biological controls to keep pest populations within acceptable limits.
- Organically approved pesticides are used if other tactics have not been adequately effective, as a last resort, and with care to minimize risks.

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Ecologically Based Pest Management

Characteristics of arthropod predators:

- Adults and immatures are often generalists rather than specialists
- They generally are larger than their prey
- They kill or consume many prey
- Males, females, immatures, and adults may be predatory
- They attack immature and adult prey
- They require pollen and nectar and additional food resources

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Ecologically Based Pest Management

Major characteristics of insect parasitoids:

- They are specialized in their choice of host
- They are smaller than host
- Only the female searches for host
- Different parasitoid species can attack different life stages of host
- Eggs or larvae are usually laid in, on, or near host
- Immatures remain on or in host; adults are free-living, mobile, and may be predaceous
- Immatures almost always kill host
- Adults also require pollen and nectar

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Habitat management Planning for Biological Control

1. Ecology of Pests and Beneficials
2. Timing
3. Identification of Strategies

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Habitat management Planning for Biological Control

1. Ecology of Pests and Beneficials

- What are the most important (economic) pests that require management?
- What are the most important predators and parasites of the pests?
- What are the primary food sources, habitat, and other ecological requirements of both pests and beneficials?

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Habitat management Planning for Biological Control

2. Timing

- When do pest populations generally first appear and when do these populations become economically damaging?
- When do the most important predators and parasites of the pest appear?
- When do food sources (nectar, pollen, alternate hosts, and prey) for beneficials first appear? How long do they last?
- What native annuals and perennials can provide habitat?

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Habitat management Planning for Biological Control

3. Identification of Strategies

- Reduction of pest habitat
- Augmentation of beneficial habitat (insectary rows)
- Trap Crops

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Strategies for Biological Control

1. Crop rotations
2. Intercropping
3. Crop diversity

Genetic diversity and disease control in rice

- China's Yunnan Province
- Goal: control of Rice blast fungus
  - moves from plant to plant as an airborne spore
- Experimental Design
  - Monocultures & mixtures of
    - Short, disease resistant rice
    - Taller, highly susceptible sticky rice

Source: Zhu, Y., Chen, H., Fan, J., Wang, Y., Li, Y., Chen, J., et al. (2000). Genetic diversity and disease control in rice. Nature, 406(6797), 718-22.

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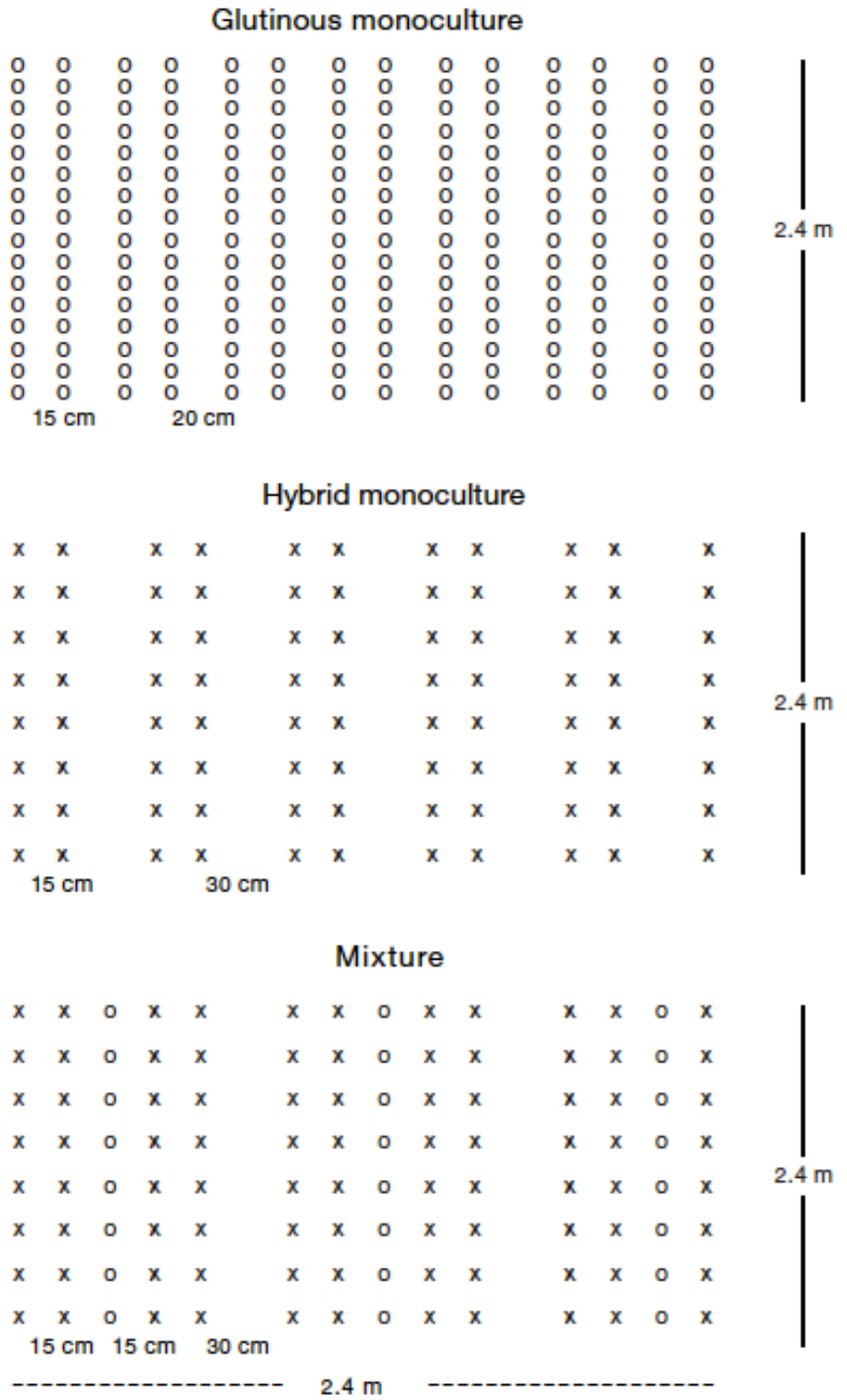

Figure 1 Planting arrangements in rice variety mixture and monoculture survey plots

Genetic diversity and disease control in rice

- Result:
- Disease-susceptible rice varieties planted in mixtures with resistant varieties had
  - 89% greater yield
  - blast was 94% less severe than in monoculture
- By the second year no fungicides were needed for blast control

Source: Zhu, Y., Chen, H., Fan, J., Wang, Y., Li, Y., Chen, J., et al. (2000). Genetic diversity and disease control in rice. Nature, 406(6797), 718-22.

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Organic Farming

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. (FAO 1999)

- An organic farm, properly speaking, is not one that uses certain methods and substances and avoids others; it is a farm whose structure is formed in imitation of the structure of a natural system; it has the integrity, the independence, and the benign dependence of an organism.
- – Wendell Berry, The Gift of Good Land, 1981

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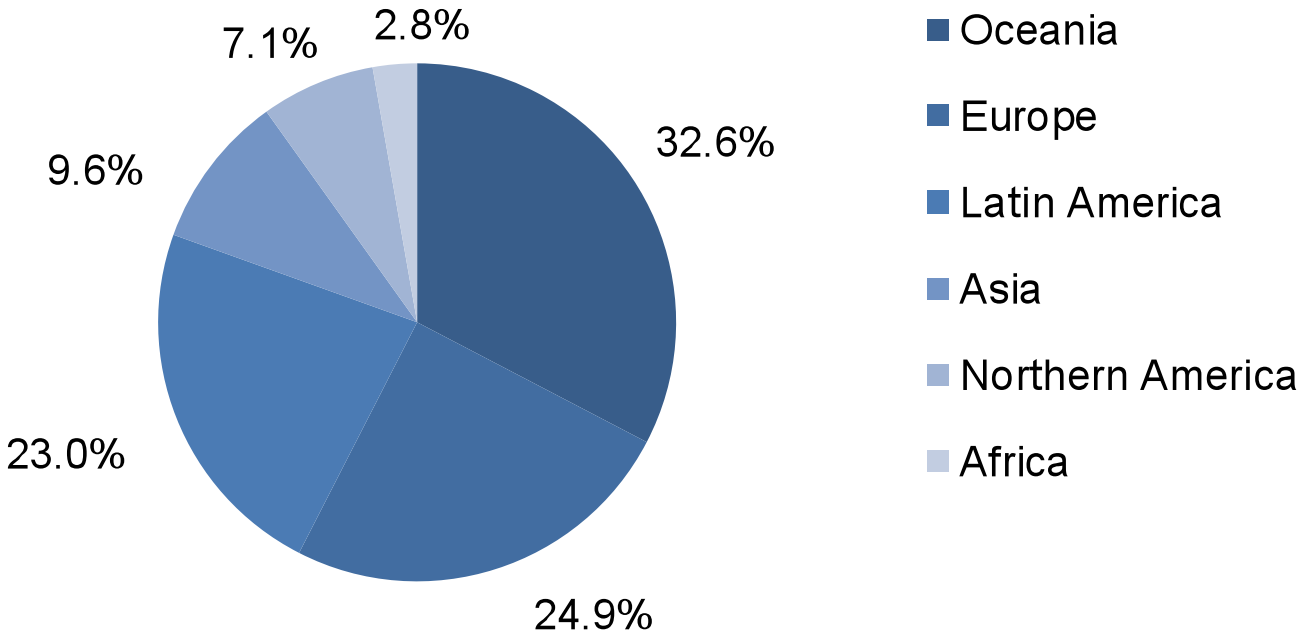
Organic Agriculture by Region- 2009



Source: FiBL & IFOAM Survey 2011

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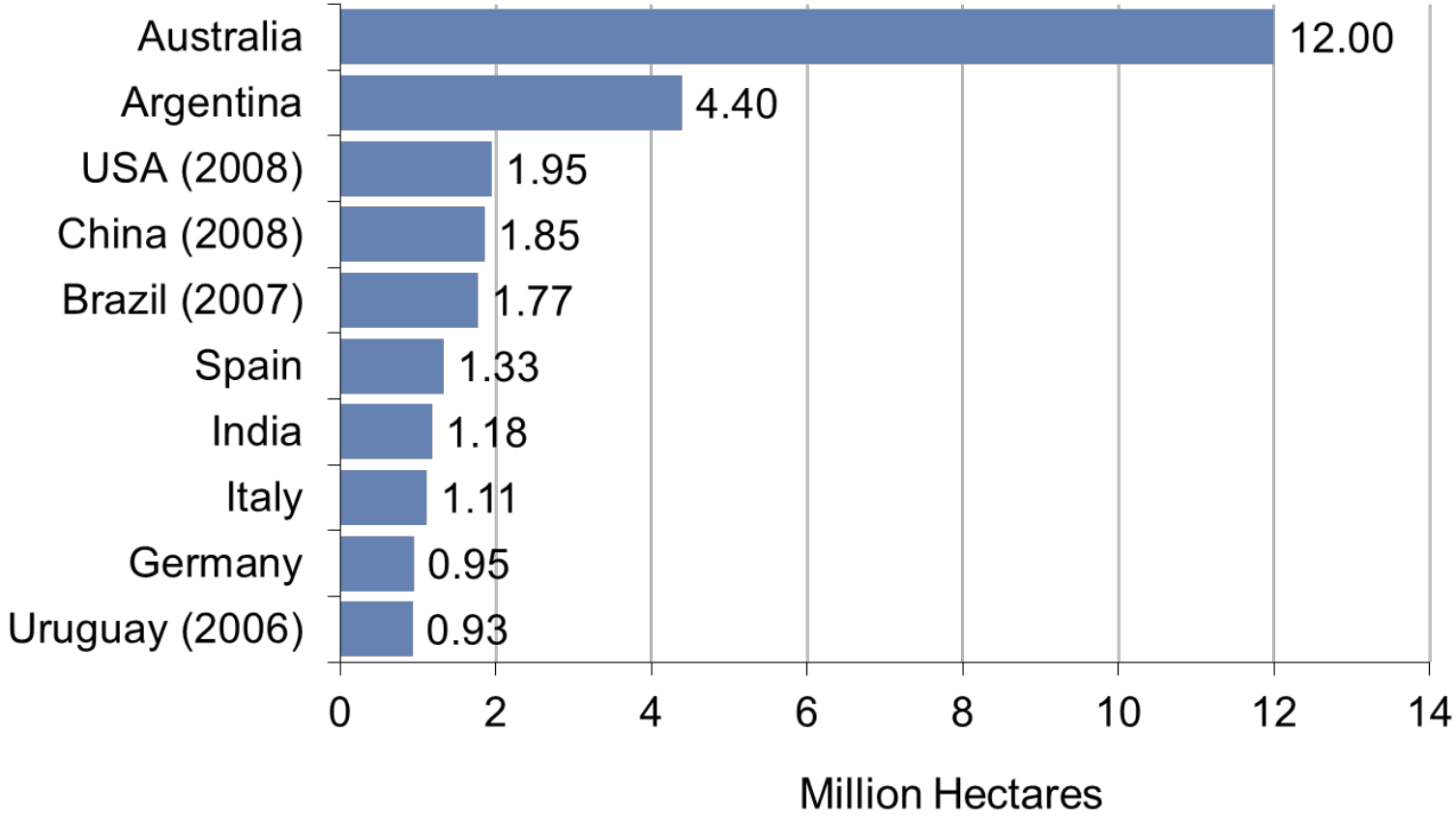
World: The ten countries with the most organic agricultural land - 2009



Source: FiBL/IFOAM Survey 2011, based on data from governments, the private organic sector and certifiers.

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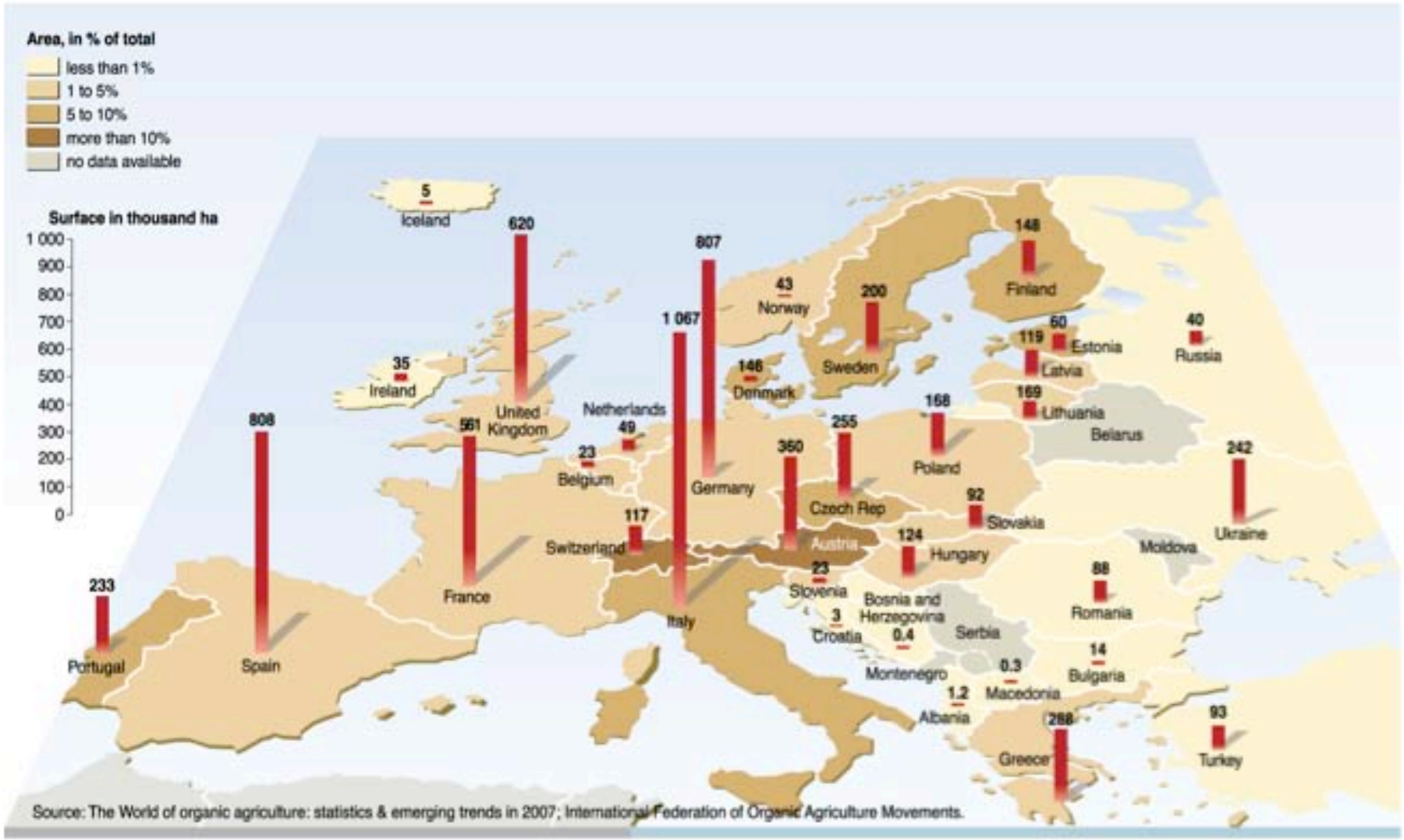
Organic farming in Europe



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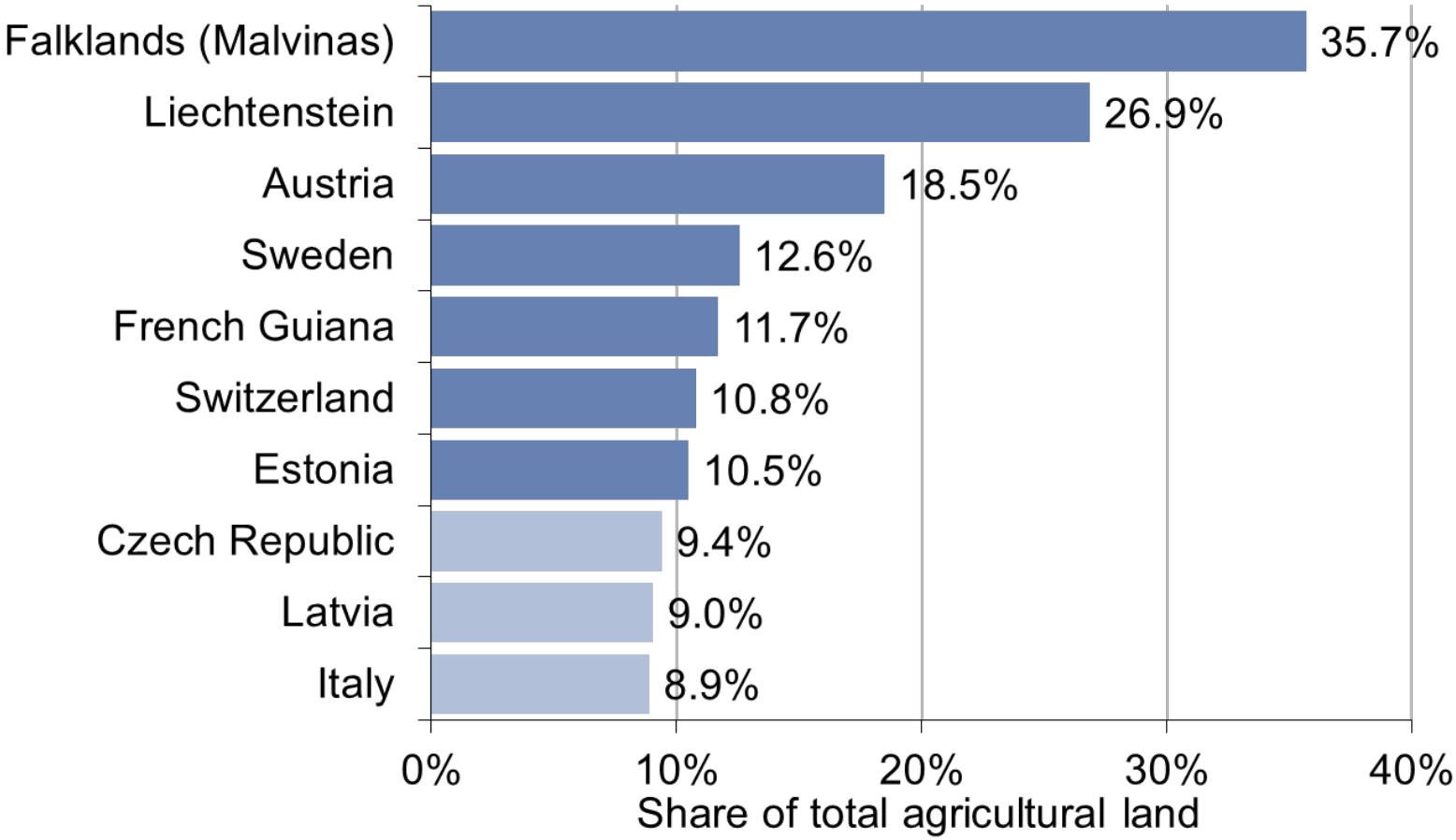
The ten countries/areas with the highest shares of organic agricultural land - 2009



Source: FiBL/IFOAM Survey 2011, based on data from governments, organic sector organisations and certifiers.

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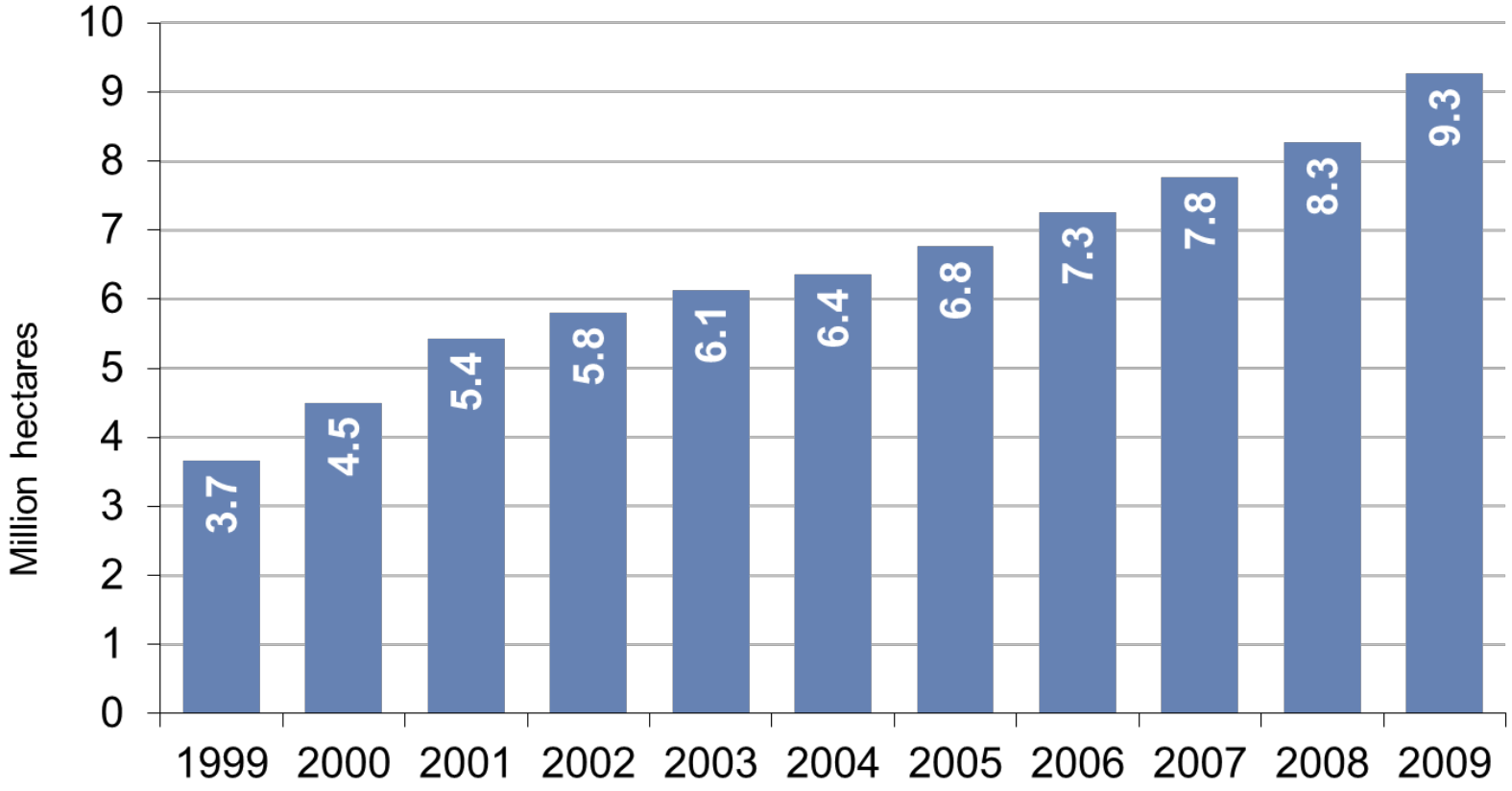
Europe: Development of organic agricultural land 1999-2009



Source: FiBL2000-2011

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Organic Farming Principles

- Minimize off-farm inputs
- Maximize the use of locally available nutrient
- Mix animal and crop production
- Add value to agricultural products
- Sell locally and direct to consumer if possible
- Minimize impacts on the environment
- Treat farm workers with respect and fairness

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Organic Farming Principles

The main focus is on:

- Soil Fertility & Plant Nutrition
- Biodiversity
- Ecological Pest Management
- Sustainability

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Soil Fertility & Plant Nutrition

Benefits: Emphasis on soil health translates into healthier food, healthier humans. Less plant disease, fewer weeds, better water-holding capacity, resistance to erosion.

Practices: Crop rotations, cover crops, green manures, animal manures, composting, minimum or no-tillage.

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Biodiversity

Benefits: ecosystem (and financial) stability, more beneficial insects, greater below-ground diversity, better nutrient cycling, disease suppression, tilth, and N-fixation.

Practices: intercropping, companion planting, establishment of beneficial habitats, crop rotations, cover crops, animal-crop integration.

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Ecological Pest Management

Benefits: Increased understanding of the whole system, protection of beneficials, don’t have to deal with toxic compounds.

Practices: Crop rotations, companion plantings, natural predators, ecosystem management, cultivation, composting, cover crops, refuges, flame, steam.

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Sustainability

Benefits: reduced energy consumption, soil conservation, efficient water use, increased water quality.

Practices: conservation structures, conservation tillage or no-tillage, controlled drainage, rotations, mulching, integrated systems.

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Benefits of Organic Agriculture

- soil conservation and maintenance of soil fertility
- reduced environmental pollution
- protection of wildlife
- increased biodiversity, diverse landscapes
- better treatment of animals
- energy efficiency
- no pesticide residues in food
- no hormones and antibiotics in animal products
- better product quality

TABLE 2
Comparison of energy efficiency (input/output) per unit of production of organic as percent of conventional farming systems.

Farming System	Reference	Energy Efficiency organic as % of conventional
Analysis for crops under organic and conventional management		
Wheat in USA	Pimentel *et al.* (1983)	+29/+70
Wheat in Germany (various studies)	Stölze *et al.* (2000)	+21/+43
Wheat in Italy	FAO (2002)	+25
Corn in USA	Pimentel *et al.* (1983)	+35/+47
Apples in USA	Pimentel *et al.* (1983)	−95
Potatoes in Germany (3 studies)	Stölze *et al.* (2000)	+7/+29
Potatoes USA	Pimentel *et al.* (1983)	−13/−20
Rotations of different crop systems in Iran	Zarea *et al.* (2000) (in FAO, 2002)	+81
Rotations of different crop systems in Poland	Kus and Stalenga (2000) (in FAO, 2002)	+35
Danish organic farming	Jørgensen *et al.* (2005)	+10
Whole system analysis (Midwest – USA) with comparable output	Smolik *et al.* (1995)	+60/+70
Crop rotations (wheat-pea-wheat-flax and wheat-alfalfa-alfalfa-flax) in Canada	Hoeppner *et al.* (2006)	+20
Apricot in Turkey	Gündomuþ (2006)	+53
Olive in Spain	Guzmán and Alonso (2008)	+50
Crop rotations	Küstermann *et al.* (2008)	+9
Results from Long-Term Agroecosystem Experiments		
Apples in USA	Reganol *et al.* (2001)	+7
Various crop systems	Mäder *et al.* (2002)	+20/+56%
Organic and animals	Pimentel *et al.* (2005)	+28
Organic and legumes	Pimentel *et al.* (2005)	+32
Organic vs. conv. with tillage	Gelfand *et al.* (2010)	+10
Organic vs. conv. no tillage	Gelfand *et al.* (2010)	−30

Source: Gomiero, T., Pimentel, D., & Paoletti, M. (2011). Environmental Impact of Different Agricultural Management Practices: Conventional vs. Organic Agriculture. *Critical Reviews in Plant Sciences*, *30*(1), 95-124.

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Organic Agriculture Legislation in EU

- Regulation (EC) 834/2007
  - (basic organic requirements)
- Regulation (EC) 889/2008
  - (detailed rules for the implementation of Reg (EC) 834/2007 on organic production and labeling)
- Guidelines issued by each member states

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Organic Certification

EU Regulations address only:

- Production method of agricultural products
- Handling processing and labeling of food

They do NOT address:

- Scale of production
- Local or regional food systems (Food Miles)
- Social Justice

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Organic Certification

Certification Process

- Develop an organic management plant
- Application is made to a certification body
- Certification body arranges for an pre-certification inspection evaluates inspection report and signs a contract with producer
- There is a transition period of 2 years for row crops and 3 years for perennial crops before a farm can be certified as organic
- Organic certification is ongoing and involves application of the organic management plan and annual inspections

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Organic Certification

EU Regulations Gray Areas

- Exceptions for organic seed & seedling requirement
- Farmyard manure sources (“factory farming origin forbidden”)
- No guidelines for restricted inputs use (rotenone, natural pyrethrins, spinosad)
- Standards for crop rotations are not defined
- Nutrient budgeting is not required
- Guidelines for contamination prevention measures are note specified
- No requirement for sustained, free-range access to pasture
- Lack of detailed guidelines for the practical protection of the environment and the habitat of wild-harvested products

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Conversion to organic agriculture

- In organic ag chemical inputs are prohibited. Key to pest management is prevention
- Increase biodiversity to promote healthy balance between pests and natural enemies
- Organic ag requires sustainable management of soil health in addition to managing crops and pests
- Certification encompasses the whole farming operation. No parallel production of organic and conventional products is allowed (with some exceptions)

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Conversion to organic agriculture

Involves a different approach to farming and farm management in terms of:

- labor demands;
- marketing strategies;
- diversification, especially in the cropping system, in order to maintain soil fertility and control weeds, pest and diseases;
- crop production practices with emphasis on mechanical weed control, biological controls,
- green manures and possibly different tillage practices;
- manure management practices
- Extensive record keeping

TABLE 1
Comparison of conventional versus sustainable farming systems.

Characteristic	Conventional System	Sustainable System
Primary energy source	Fossil fuels + sunlight	Contemporary sunlight
Source of nutrients	Chemical fertilizers	Manure, compost, rotations, cover crops
Pest management	Chemical applications	Crop rotations, resistant cultivars, tillage
Crop cultivars	Maximum yield potential, GMOs in many systems	Sustainable yield with moderate inputs, no GMOs
Tillage	Moving toward no-till with chemical herbicides	Tillage for weed management
Crop rotations	Short rotations to maximize profits from two crops	Long rotations to seek pest management and fertility
Farm size	Large, and goal often to expand	Small to moderate, goal is to stabilize operation
Labor source	Family plus hired labor for expanded farm size	Family only (if possible) plus hired for specialty products
Crop/animal integration	Specialized in either crops or livestock	Crops and livestock integrated on farm
Number of crops and other enterprises/farm diversity	Limited to two crops, sale to conventional buyers	Diverse mix of crops/animals and sale of diverse products
System resilience	Low, subject to changes in markets, fuel costs	Moderate, income sources buffered by diversity
Level of biodiversity on farm	Low, with monoculture crops and two-year rotation	Moderate to high, with many crops + livestock

Source: Francis, C. a, & Porter, P. (2011). Ecology in Sustainable Agriculture Practices and Systems. *Critical Reviews in Plant Sciences*, *30*(1), 64-73.

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Myths & Realities about converting to organic agriculture

Myth	Reality
Yields will be miserable.	Yields are comparable under well managed systems.
Pests will eat you up.	Most pest problems can be prevented using integrated approaches.
Weeds will take over your farm.	Weed management requires constant attention.
Transitioning is impossible.	Transition can be challenging: plan cash flow with budget projections.
The paperwork will kill you.	Recordkeeping can help your operation in many ways in addition to organic compliance.
You'll never make any money.	Organic certification expands your market options and often gives premium prices.
It can't be done.	It can be done if you plan, persist, and ask for help when you need it.

Source: National Sustainable Agriculture Information Service - ATTRA

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Case Study – Organic No-Till

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Rodale Institute developed a roller system for applying No-Till methods in organic farming.

Organic corn planted over
rolled oat cover crop

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3. Conclusions

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3.i. Summary

- Agroecological design applies principles of natural ecosystems to ecological agriculture
- Agroecological strategies include building strengths above ground and building soil health
- Habitat management can enhance biological pest control
- Organic farming is a holistic production management system
- Organic agricultural land is increasing worldwide
- Organic agriculture helps soil conservation, environmental protection, increase biodiversity and energy efficiency
- Conversion to organic agriculture involves a different approach to farming and with proper management can be both productive and financially profitable.

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Thank you for your attention!

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3.ii. References - Basic bibliography

1. Basic text on agroecology. Please read Chapters 2, 5, 9, 10.
   - Altieri, M. A., & Nicholls, C. I. (2005). Agroecology and the search for a truly sustainable agriculture. Basic Textbooks for Environmental Training. UNEP.
2. A paper on the potential of organic agriculture to meet world food need, based on research and case studies in organic farming
   - Vasilikiotis, C. (2000). Can Organic Farming “Feed the World”Á Á? The Natural Farmer, 16-18.
3. The regulations that govern organic production and labeling in the European Union.
   1. Regulation (EC) No. 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91
   2. Regulation (EC) No. 889/2008 of 5 September 2008 with detailed rules on production, labelling and control
4. A review article on habitat management in Ecologically Based Pest Management (EPBM)
   - Landis, D. a, Wratten, S. D., & Gurr, G. M. (2000). Habitat management to conserve natural enemies of arthropod pests in agriculture. Annual review of entomology, 45, 175-201.
5. A review article comparing organic and conventional agriculture in terms of energy use, CO2 emissions and environmental performance
   - Pimentel, D., Hepperly, P., Hanson, J., Douds, D., & Seidel, R. (2005). Environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems. BioScience, 55(7), 573–582. Univ California Press.

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Complementary bibliography

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2. A farmer-based tool for monitoring the effects of farm management on soil quality and crop health
   - Nicholls, C. I., Altieri, M. A., Dezanet, A., Lana, M., Feistauer, D., & Ouriques, M. (n.d.). A Rapid, Farmer-Friendly Agroecological Method to Estimate Soil Quality and Crop Health in Vineyard Systems. Quality, 33-40.
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   - Altieri, M. A. (1995) Agroecology: the science of sustainable agriculture. Westview Press. Boulder.
4. Letourneau, Deborah K, and Sara G Bothwell. 2008. Comparison of organic and conventional farms: challenging ecologists to make biodiversity functional. Frontiers in Ecology and the Environment 6, no.8
5. Review article exploring the potential for organic agriculture to contribute to the global food supply
   - Badgley, C., Moghtader, J., Quintero, E., Zakem, E., Chappell, M. J., Aviles-Vazquez, K., et al. (2007). Organic agriculture and the global food supply. Renewable Agriculture and Food Systems, 22(02), 86.
6. Research paper on crop rotations and no-till agriculture
   - Gregory, M. M., Shea, K. L., & Bakko, E. B. (2005). Comparing agroecosystems: Effects of cropping and tillage patterns on soil, water, energy use and productivity. Renewable Agriculture and Food Systems, 20(2), 81-90. Cambridge University Press.

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Web pages / links

- European Commission web site on Organic Farming *http://ec.europa.eu/agriculture/organic/home_en*
- FAO Organic Agriculture Programme *http://www.fao.org/organicag*
- International Federation of Organic Agriculture Movements (IFOAM) *http://www.ifoam.org/*
- ATTRA - National Sustainable Agriculture Information Service Publications:

  1. Dufour, R. 2000. Farmscaping to Enhance Biological Control - Pest Management Systems Guide. http://www.attra.org/attra-pub/farmscape.html

  2. Biorationals: Ecological Pest Management Database http://attra.ncat.org/attra-pub/biorationals/

  3. Organic IPM Field Guide http://www.attra.org/attra-pub/summaries/summary.php?pub=148

  4. Biointensive Integrated Pest Management (IPM) http://www.attra.org/attra-pub/ipm.html

- eXtension – Organic agriculture *http://www.extension.org/organic%20production*
- HowToGoOrganic™.com – Pathway to Organic for Producers *http://www.howtogoorganic.com/index.php?page=producers/*

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IFOAM principles

Health

Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

Ecology

Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

Fairness

Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

Care

Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

For more information on unit C534a.1

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